REMARKS/ARGUMENTS

Favorable reconsideration of this application in light of the present amendments and following discussion is respectfully requested.

Claims 1-69 are presently active. Claims 1, 32, 63, and 66 have been presently amended.

In the outstanding Office Action, Claims 1-69 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting over Claims 1-44, 1-58, 1-48, 1-78, and 1-62 of co-pending Application Nos. 10/673,138; 10/673,467; 10/673,501; 10/673,507; 10/673,583; and 10/673,583, respectively. Claims 1-25, 32-56 and 63-69 were rejected under 35 U.S.C. § 103(a) as being obvious over Sonderman et al (U.S. Pat. No. 6,802,045) in view of Kee et al (U.S. Pat. No. 5,583,780). Claims 26-31 and 57-59 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Sonderman et al and Kee et al in view of Fatke et al (U.S. Pat. Appl. No. 200510016947).

Regarding the rejection on the merits:

Claim 1 defines a method for analyzing a process performed by a semiconductor processing tool including:

> 1) inputting process data relating to an actual process being performed by the semiconductor processing tool,
> 2) inputting a first principles physical model including a set of computer-encoded differential equations, the first principles physical model describing at least one of a basic physical or chemical attribute of the semiconductor processing tool,
> 3) performing a first principles simulation for the actual process being performed ***during performance of the actual process*** using the physical model to provide a first principles simulation result in accordance with the process data relating to the actual process being performed in order to simulate the actual process being performed, ***said first principles simulation result being produced in a time frame shorter in time than the actual process being performed***; and
> 4) using the first principles simulation result ***obtained during the performance of the actual process*** to determine a fault in the actual process being performed by the semiconductor processing tool.

The claim defines clearly a process where data input from an actual process being performed is used for producing a first principles simulation result, which is produced for the actual process being performed during performance of the actual process. The result obtained is produced in a time frame shorter in time than the actual process being performed.[1] The result is then used to determine a fault in the actual process being performed by the semiconductor processing tool.

The Office Action makes clear on page 13 that the Examiner and the Applicant disagree as to whether or not Sonderman et al teach a a first principles simulation that is performed for the actual process being performed during performance of the actual process. The Examiner relies on the "environments as shown in Fig. 2" and states on page 14 of the Office Action that these can "of course be performed currently and any order." The Office Action thereafter refers to Figure 3 of Sonderman et al for a showing of a simulator that controls the process. Figures 2 and 3 of Sonderman et al are reproduced below:

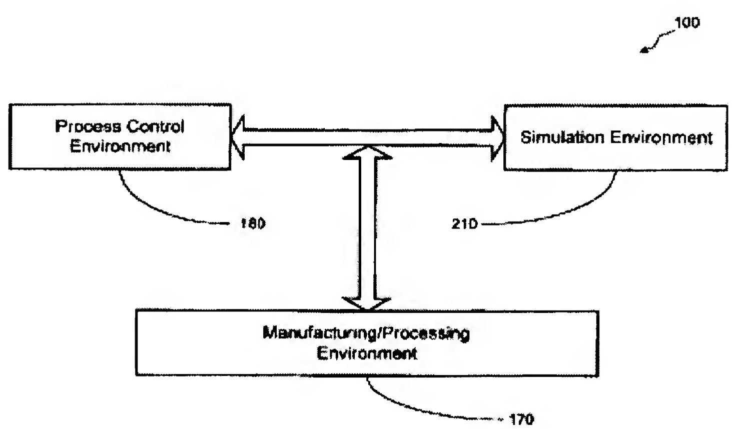

FIGURE 2

[1] Specification, page 15, numbered paragraph [0057], in the filed specification:
In this embodiment, steady-state simulations are repeatedly run concurrently with the process by using the physical sensor measurements to repeatedly uipdate boundary conditions of the first principles simulation model.

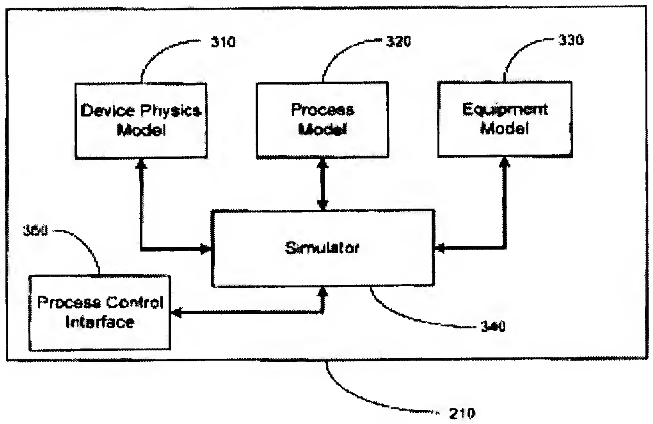

FIGURE 3

Neither Figure 2 nor Figure 3 shows that a simulation result is being performed during an actual process. The issue is whether or not the simulator in Sonderman et al performs a simulation ahead of the process run or during the process run. Whether the simulator in Sonderman et al can "of course be performed currently and any order," as asserted by the examiner, is not the legal standard for obviousness. M.P.E.P. § 2143.03 requires, to establish a case of *prima facie* obviousness, all the claim limitations must be taught or suggested by the prior art.

The Office Action specifically refers on page 13 to the teachings of Sonderman et al at col. 7, lines 1-20 and col. 8, lines 1-11. Sonderman et al at col. 7, lines 1-20, merely state that the simulation environment can emulate the operations of an actual process control environment, but provides no details of the time frame of when the simulation occurs. Sonderman et al at col. 8, lines 1-11, merely indicate that system 100 and the simulation environment 210 can simulate the real online manufacturing effects, but likewise provides no details of the time frame of when the simulation occurs.

Applicant respectfully points out that, at col. 9, lines 46-51, Sonderman et al specifically states:

> The system 100 ***then*** optimizes the simulation (described above) to find more optimal process target (T_i) for each silicon wafer, ***S_i to be processed***. These target values are then used ***t***o generate ***new control inputs, X_{Ti},*** on the line 805 to control ***a subsequent process of a silicon wafer S_i***. [Emphasis added]

The plain reading of this section of Sonderman et al is that the system 100 ***then*** (e.g., at time T1) optimizes the simulation for each silicon wafer, ***S_i to be processed*** (e.g., later at time T2). In other words, the simulation results of Sonderman et al produce a new control input for each silicon wafer ***to be processed***. Thus, Applicant respectfully submits that Sonderman et al teach performing first principles simulation for the actual process to be performed ***before*** performance of the actual process, and **not** the claimed performing first principles simulation ***for the actual process being performed during performance of the actual process***.

Other sections of Sonderman et al support Applicant's position on this matter.

For example, Figure 4 of Sonderman et al was pointed out for clearly showing that the simulation results are produced ***ahead of performing a process*** and thus have to be based on historical data, and not based on the actual process being performed during performance of the actual process.

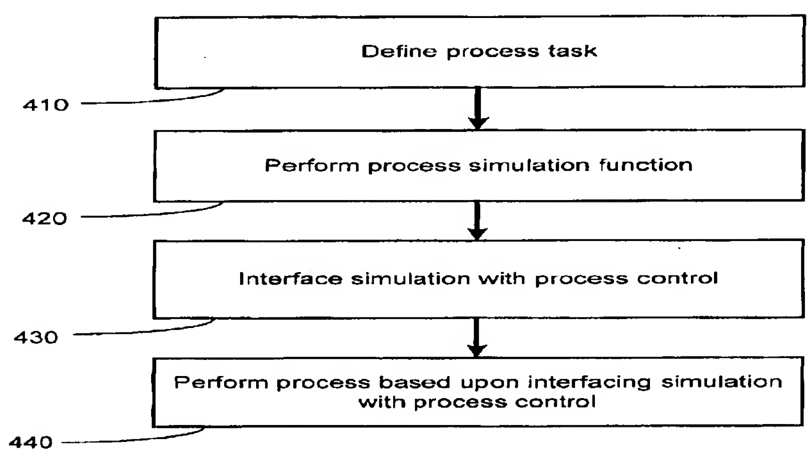

FIGURE 4

With reference to Figure 4, Sonderman et al disclose at col. 6, lines 24-47:

> Turning now to FIG. 4, a flow chart representation of the methods in accordance with the present invention is illustrated. In one embodiment, ***the system 100 defines a process task that is to be performed (block 410).*** The process task maybe a photolithography process, an etching process, and the like. ***The system 100 then performs a process simulation function*** (block 420). A more detailed description of the process simulation function described in block 420, is illustrated below. In one embodiment, a simulation data set results from the execution of the process simulation function.
>
> ***Once the system 100 performs the process simulation function, the system 100 performs an interfacing function***, which facilitates interfacing of the simulation data with the process control environment 180 (block 430). The process control environment 180 can utilize the simulation data in order to modify or define manufacturing control parameters that control the actual processing steps performed by the system 100. ***Once the system 100 interfaces the simulation data with the process control environment 180, the system 100 then performs a manufacturing process*** based upon the manufacturing parameters defined by the process control environment 180 (block 440). [Emphasis added]

Hence, the process flow in Sonderman et al is straightforward:

1) define process to be modeled,

2) model process for simulation result,

3) interface simulation result to processor, and then

4) run the process under control based on the pre-existing simulation result.

Moreover, Sonderman et al support Applicant's position on this matter. Sonderman et al at col. 4, line 65, to col. 5, line 10 describe that:

> Furthermore, the simulation environment 210 can be ***used for feedback modification*** of control parameters invoked by the process control environment 180. For example, the manufacturing environment 170 can send metrology data results into the simulation environment 210. The simulation environment 210 can then use the metrology data results and perform various tests and calculations to provide more accurate, modified control parameters to the process control environment 180. A feedback loop in then completed when the process control environment 180 sends the modified or adjusted process control parameters to the manufacturing environment 170 for further processing of semiconductor wafers. [Emphasis added.]

Applicant respectfully points out that this description in Sonderman et al of feedback modification of control parameter is by definition the control of ***future wafers*** based on what

has already occurred to a previous wafer. Hence, this section also supports Applicant's position that Sonderman et al do not disclose and indeed ***teach away*** from the present invention where data input from an actual process being performed is used for producing a first principles simulation result, which is produced for the actual process being performed during performance of the actual process.

Lastly, with regard to Sonderman et al, Sonderman et al do not disclose or suggest that a simulation result is produced in a time frame shorter in time than the actual process being performed, as presently defined in the independent claims.

The deficiencies in Sonderman et al are not overcome by Kee et al. Kee et al deal with the process control of a Rapid Thermal Processing (RTP) tool and do **not** use real time modeling. Kee et al in detail disclose at col. 4, lines 21-51, that:

> The modeling apparatus 101 of the instant invention may also be used to perform an inverse analysis to establish the boundary conditions or parameter values required to achieve a certain function of the thermal system. This allows the apparatus to be used to establish the appropriate process parameters and boundary conditions for the thermal system modeled. In accordance with the instant invention, the inverse analysis can be directly carried out by the modeling apparatus ***rather than using the conventional approach, which merely solves the direct problem repeatedly, in a lengthy and costly iterative process***, to determine appropriate input parameters to achieve a desired result. In other words, in accordance with the instant invention, ***once a particular thermal process is modeled for a particular set of control parameters***, the device may then be used to automatically obtain the necessary control parameters to achieve a desired result by providing the modeling apparatus with parameters corresponding to the desired result.
>
> To carry out the inverse analysis, the modeling apparatus 101 includes an inverse parameter input section 104 also connected to input device 103. A user inputs into the modeling apparatus 101 parameters corresponding to desired results, e.g., desired temperature characteristics of the system, which are stored in memory 108. The processing unit 110, under control of modeling program 111, ***uses the previously generated model*** of the thermal system and the parameters held in memory 108 and derives or predicts particular control parameters to meet the constraints entered through the inverse parameter input section 104. This process is more fully described below in connection with the examples provided.[2] [Emphasis added]

[2] Kee et al, col. 4, lines 21-50.

Hence, Kee et al explicitly disclose that the ***predicted*** model of the thermal system is used to design and control the thermal system. Kee et al exemplify the difficulties of a "conventional approach" which merely solves the spectral radiation transport equations through "a lengthy and costly process." These problems forced Kee et al to use ***pre-generated model results*** for a control process of a RTP process.

The Examiner points out on page 16 of the Office Action Kee et al's description at col. 7, lines 3-10, that modeling apparatus executes quickly ... and as described above, may be used in design and real-time control systems." Yet, Applicant submits that, "as described above" would refer to the pre-generated model results discussed above. The Examiner points out on page 16 of the Office Action Kee et al's description at col. 5, lines 15-17, that "modeling apparatus 101 can be used to develop real-time control systems." Yet, when reading Kee et al as a whole (including the first passage reproduced above and the passage reproduced below), it is clear that the real-time control systems in Kee et al use the pre-generated model results. The Examiner points out on page 16 of the Office Action Kee et al's description at col. 5, lines 36-45, that:

> When the modeling apparatus 101 of the instant invention is connected to the control system development tool 120, concurrent engineering of equipment design and control programs can be carried out. In this manner, the thermal system may be modeled in the modeling apparatus 101, and physically based simulations may be run under the control of the ***very same process-control software that would eventually be loaded into the actual controllers*** of the thermal system 130 being concurrently designed in real-time (i.e., on the time scale of the actual thermal process). [Emphasis added.]

Hence, even this passage also makes clear that, in Kee et al, the simulation is run first and then "loaded into the actual controller." Thus, Kee et al use a pre-generated model to control the rapid thermal processor.

Accordingly, when read as a whole, the descriptions in Kee et al teach away from the presently claimed invention where data input from an actual process being performed is used

for producing a first principles simulation result, which is produced for the actual process being performed during performance of the actual process, and is produced in a time frame shorter in time than the actual process being performed.

The Supreme Court in *KSR International Co. v. Teleflex Inc. et al. 2007 U.S. LEXIS 4745* reinforced the role of "teaching away" in deciding obviousness. The Court stated that:

> In *United States v. Adams*, 383 U. S. 39, 40 (1966), a companion case to *Graham*, the Court considered the obviousness of a wet battery that varied from prior designs in two ways: It contained water, rather than the acids conventionally employed in storage batteries; and its electrodes were magnesium and cuprous chloride, rather than zinc and silver chloride. The Court recognized that when a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result. 383 U. S., at 50-51. It nevertheless rejected the Government's claim that Adams's battery was obvious. The Court relied upon the corollary principle that when the prior art ***teaches away*** from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious. *Id.*, at 51-52. When Adams designed his battery, the prior art warned that risks were involved in using the types of electrodes he employed. The fact that the elements worked together in ***an unexpected and fruitful manner*** supported the conclusion that Adams's design was ***not obvious*** to those skilled in the art. [Emphasis added.]

In the present situation, the claimed method of performing a first principles simulation ***for the actual process being performed during performance of the actual process*** produces ***more than an expected result*** in that Sonderman et al (in having to develop a ***new control inputs*** for each subsequent wafer) can not compensate for real time excursions from the existing model occurring while the wafer is being processed. In other words, the lengthy time for generation of a first principles model simulation in the prior art prevents one from realizing a real time process control based on a first principles simulation during the actual process. Hence, the claimed processes and systems produce ***an unexpected result*** in that the first principles simulation result is produced in a time frame shorter in time than the actual process being performed.

For all these reasons, Applicant submits that the present invention patentably defines over Sonderman et al and Kee et al.

Regarding the provisional double-patenting rejection:

Applicant submits that a terminal disclaimer can be filed, if the claims in the present application and the claims in the co-pending Application Nos. 10/673,138; 10/673,467; 10/673,501; 10/673,507; 10/673,583; and 10/673,583 remain obvious in view of each other at the time of allowance of either of these applications. Indeed, M.P.E.P. § 804.02 IV states that, prior to issuance, it is necessary to disclaim each one of the double patenting references applied. Hence, Applicant respectfully requests that the examiner contact the undersigned should the present arguments be accepted and should the case be otherwise in a condition for allowance. At that time, a terminal disclaimer can be supplied to expedite issuance of this case.

Conclusion:

As discussed above, the issues identified in the outstanding Office Action for this patent application have been addressed, placing all the claims in a condition for allowance.

Consequently, in view of the above discussions, the application is believed to be in condition for formal allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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